# APPENDIX D

# REVIEW OF THE NATIONAL URBAN WATER PLANNING PRINCIPLES – LITERATURE REVIEW

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## Introduction

The original aim of this literature review was to analyse leading practice in urban water planning since 2008, thereby enabling a better understanding of how urban water planning practice has changed since the introduction of the National Urban Water Planning Principles (the Principles) in 2008, both in Australia and internationally.

A literature search yielded a significant amount of material on recent developments in infrastructure planning approaches, such as risk or adaptive planning (although not necessarily specifically related to urban water), and on the concepts of integrated urban water management and water-sensitive urban design. There also appears to be an emerging body of literature discussing the urban water sector’s institutional barriers to implementing adaptive planning approaches.

However, very little recent work was found on urban water planning overall, either in Australia or internationally, such as a critical analysis of various planning methods or a historical account of planning developments. Furthermore, no information was found on urban water planning principles or guidelines (other than Australia’s).

For that reason, the scope of this literature review has been modified: it now consists of a selective review of literature published since 2008 that relates to ‘new’ approaches to urban water planning (such as adaptive management); and a brief examination of the urban water plans from four cities in English-speaking countries – London, San Francisco, Auckland and Santa Fe. The purpose of this latter component is to provide some insight into the differences and similarities between the concepts expressed in the Principles, and the urban water planning arrangements of the selected cities.

### Definitions

Adaptive management approaches can generally be defined as systematic strategies for improving management policies and practices by learning from the outcomes of previous management actions.[[1]](#footnote-1) Adaptive management emphasises the importance of the management process rather than focusing on goals, but without claiming that the process is an end in itself. It explicitly recognises that management strategies and even goals may have to be adapted during the process as new information becomes available, and that the quality of the process – for example, who is involved and which kind of information is taken into account – is recognised as essential for the achievement of desired outcomes.

Adaptive management can be viewed as an extension of risk management; the objective is to minimise, control or eliminate the likelihood of negative impacts occurring as a result of an event or situation. In their examination of the application of risk, vulnerability and adaptive management in the water sector, Smith et al (2013) found that there is no universally agreed definition of risk. However, the authors comment that risk management is generally accepted to be an iterative process that typically encompasses certain generic stages. Also, because risk is based on uncertainty, a risk management process must be monitored and reviewed as new information becomes available and preconditions change.

Real options planning can be conceptualised as one of several possible adaptive management techniques. It is used to help organisations decide how to allocate resources, and specifically whether, when and how to invest capital in assets.[[2]](#footnote-2) It involves the assignment of risks and probabilities to different scenarios, with a strong emphasis on organisational flexibility in order to better plan for, and manage, future uncertainty.

### Productivity Commission and National Water Commission recommendations

In 2011, the Commonwealth Government released two major reports on the urban water sector, authored by the Productivity Commission (PC) and the National Water Commission (NWC). Both reports examine issues associated with urban water planning, including approaches such as adaptive management and real options. In summary:

* The PC recommended that state and territory governments should consider the costs, benefits and risks of all urban water supply augmentation and demand management options, using a real options or adaptive management approach.
* The NWC recommended that governments should review policy settings to allow an efficient portfolio of urban water supply and demand measures to emerge and evolve over time, and that water service providers should adopt adaptive and risk-based approaches to supply-demand planning.

The PC stated that achieving water security at the lowest expected cost requires that supply augmentation and demand management be considered together, and suggests that urban water planners consider all supply augmentation options. The report noted that making efficient supply augmentation decisions requires a sophisticated approach to dealing with uncertainty, with a real options approach put forward.

However, both the PC and the NWC acknowledge that the full potential of a real options approach cannot be achieved without the development and use of data, specialised analytical tools and administrative processes.

## Adaptive management and real options planning

### Inclusion in the National Urban Water Planning Principles

None of the Principles explicitly recommend the use of adaptive/risk management or real options planning. However, Principles 2, 5 and 8 capture key elements of an adaptive management approach:

* Principle 2: base urban water planning on the best information available at the time and invest in acquiring information on an ongoing basis to continually improve the knowledge base. Principle 2 states that urban water planning should be based on scenario planning, incorporating uncertainty, and that information on possible future changes is important to determine an acceptable level of risk.
* Principle 5: consider the full portfolio of water supply and demand options. Although its focus is on integrated urban water management, it states that consideration of a range of options helps to optimise outcomes and reduce system reliability risks, and that ‘readiness options’ should be identified as part of contingency planning.
* Principle 8: periodically review urban water plans. The main reason for reviewing plans is to take account of any changes to a utility’s operating environment (such as in population) so system analyses and future projections can be amended. In addition, Principle 8 could be interpreted to mean that planning should recognise that some demand management responses are short term and are required to be adaptive, while other responses have a longer planning horizon due to the relevant assets’ lifespan.

### Literature findings

#### Conceptual analysis

In the literature reviewed for this project, adaptive management approaches, including real options analysis, were frequently recommended for addressing the complexities of contemporary urban water planning. Some commentators (e.g. WSAA 2008) viewed real options as being one of several possible tools, while others viewed the concepts inherent to the two approaches (such as risk, resilience, adaptivity) as being interrelated (Smith et al 2013).

In the same year the Urban Water Planning Principles were agreed, the Water Services Association of Australia released an issues paper (WSAA 2008) about the potential benefits of real options theory for urban water supply decisions. The approach was recommended for its ‘powerful’ insights in risk management of uncertainties such as climate change, thereby enhancing investment flexibility over time. Acknowledging that there are a variety of methods for applying real options in practice, the paper includes examples of its application in Australia, such as the Western Australian Water Corporation’s decision to diversify its water sources, and the planning, approval and tender process undertaken by Sydney Water for its desalination plant prior to taking the decision to build it.

Since 2008, other commentators have made similar appraisals of these management approaches (e.g. Smith 2013, Clarke 2012, Mukheibir 2012, OECD 2013, WSAA 2014). In a general sense, adaptive management is considered to be a departure from the previous linear step-wise process of urban water planning to one that reflects an interdependent process of continual input and updating. In practical terms, adaptive management treats measures as experimental, advocates the need to learn from the outcomes, and adjusts practices accordingly. Management systems can thereby remain flexible and adjustable in response to unforeseen changes.

Adaptive management, and its accompanying characteristic of resilience, are depicted as a shift away from conventional ideas of risk and stability towards a more dynamic approach. This involves accepting a certain degree of uncertainty, mitigated through enhanced learning, experimentation and collective action. As the OECD (2013) states, it is usually too expensive, and often technically impossible, to fully eliminate water-related risks. Indeed, water security is about learning to live with an acceptable level of water risk, but doing so successfully necessitates knowing, targeting and managing those risks.

In the context of urban water planning, Clarke et al (2012) acknowledge that real options approaches are attractive in that they explicitly address the uncertainties and irreversibility of investments. Both Clarke et al and WSAA (2014) recommend that urban water planners identify flexible portfolios of water servicing options, with the aim of having a diversified source of water supply. This allows for an assessment of the relative merits of all options, based on both cost and other criteria, but with a focus on managing risk, such as different rainfall probabilities.

For example, WSAA advocates that planners envisage infrastructure assets as temporary or having multiple uses and functions over their long lives. Mukheibir et al (2012) point to the increasing focus on diversified portfolios and flexible strategies as a means of providing improved security and resilience at reduced cost. By assembling portfolios of response measures in response to potential scenario paths, investment strategies that produce a set of least cost portfolios to address the range of scenarios can be identified.

Once options have been identified, decisions about their implementation are informed by a set of policy parameters for the sequencing and prioritisation of options, the thresholds and triggers for new options, and constraints of existing options (Clarke et al 2012). The risk and consequence of not meeting objectives, the value of investment and the value of opportunities influence the prioritisation of options. The OECD (2013) emphasises the importance of timing in successfully managing risks – an effective approach being one that moves from reactive (for example, to natural disasters such as floods), to more proactive policies of managing risks in advance and reviewing them on a regular basis.

The OECD (2013) also recommends the use of economic instruments, such as charging ‘appropriately’ for water use and wastewater management, to help achieve acceptable levels of risk at least possible cost. The authors suggest that the introduction of water scarcity pricing would help reduce demand to levels that could avoid the premature construction of new water supply infrastructure. As an example, they cite analysis that suggests the Sydney desalination plant may not have been required if scarcity pricing had been introduced at an appropriate time. Surprisingly, this was the only reference reviewed that included pricing as a component of the urban water planning process, as is advocated by National Urban Water Planning Principle 7 (‘use pricing and markets to help achieve planned urban water supply/demand balance’).

#### Adaptive management and the role of climate change

For its capacity to affect rainfall patterns and the consequent impact on urban water supply and management, climate change has become one of the key determinants of urban water planning.

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report forecasts a long-term drying over southern areas of Australia during winter, particularly in the south-west, and a long-term rainfall decline over southern and eastern areas during spring. Hydrological modelling included in the report indicates that freshwater resources in south-east and south-west Australia will decline by 0–40 per cent and 20–70 per cent respectively for 2°C warming above 1990 levels. This is due largely to the decline in rainfall during the cooler seasons, when most of the runoff in southern Australia occurs. However, the report also states that there continues to be a high degree of uncertainty in projected rainfall changes for many parts of Australia. Other commentators (e.g. Bates et al 2010) agree that the impacts of future climate change on the water sector will be complex and at least in part unpredictable.

Skinner (2010) sees the impacts of climate change as challenging the fundamental assumptions about planning and operating assets and systems. Managing climate change is largely about managing risks associated with the gradual but persistent changes in average climatic conditions. Zhou et al (2013) point out that adaptive management approaches are all the more attractive in the context of the need to cope more deliberately and sustainably with future climatic variability.

Maani (2012) proposes that the inherent uncertainty in climate change and its effects is exacerbated by the complexity of the decision-making environment, characterised by multiple institutions and affected stakeholders; frequent policy changes; and changes in regulations, governments and local community demands and influences. He characterises climate change adaptation as a ‘wicked’ problem requiring collective learning and new modes of decision-making and collaboration. While he claims that there is no single approach to planning and decision-making for adaptation, he identifies certain key ingredients for successful adaptation planning. These ingredients are similar to elements of adaptive management: understanding vulnerability, managing risk, scenario planning and identifying synergies.

In terms of practical approaches for urban water planners, most commentators agree on the need to adopt planning processes that better integrate across traditional and non-traditional supply sources and incorporate the likelihood of future climate shocks. WSAA (2014) recommends an approach that comprises a resilient and diverse portfolio of options, capable of being updated as technology evolves, and weighted by risk. Bates (2010) suggests that plans directed at mitigating specific but highly uncertain outcomes are unlikely to be cost-effective, and recommends instead constructing plans as a range of possible actions. In this context, he defines the features of a real options approach as creating a right, but not an obligation, to undertake a decision – usually the option to make or abandon a capital investment. Bates also notes the need to rethink the types of relationships and organisational cultures in order to develop solutions to the complex problems created by climate change impacts.

#### Implementation of ‘new’ approaches: barriers and enablers

There is a significant amount of literature regarding the *theory* associated with adaptive management approaches and the associated implications for urban water planning. However, it was difficult to find evidence of the extent of *implementation* of these approaches in the urban water sector, particularly in Australia.

Based largely on an analysis of international experience, both Smith et al (2013) and Zhou et al (2013) found that the transition towards adaptive management approaches in the urban water sector is slow. Smith et al (2013) found that the concepts of risk and vulnerability are more widely applied and strongly embedded than resilience and adaptive management. For example, when water service provider staff were asked about the concept of resilience, their response tended to be focused on the engineering aspects of their business. Only a very few respondents linked resilience with a need for more flexibility and coherence in their organisation’s management.

Several authors (Smith, Zhou, Bettini) acknowledge that the need to reconfigure urban water systems to meet future challenges is well described from a technical perspective. However, they note that there has been less consideration of the need to adjust the institutions which frame the management of these systems. For example:

* Smith et al (2013) point out that building flexibility into a system based around hard assets is challenging, particularly in a sector where there are numerous incentives to stick with ‘tried-and-true’ technologies and approaches. The capacities to learn, adjust and innovate are the practical outcomes that tie adaptive management closely to resilience.
* Zhou et al (2013 focus on the different governance arrangements associated with traditional and adaptive water management approaches. Traditional water management represents a predict and control approach, which relies on a centralised and hierarchical government structure, whereas adaptive water management is characterised by a decentralised and more horizontal structure at multiple scales.

From an Australian perspective, in 2008 the WSAA stressed that without either learning or flexibility on the part of the relevant organisation(s), there is no added value in the real options approach. An options portfolio needs constant monitoring of triggers for investment (such as population growth, or climate outcomes), and of the plan’s ‘readiness’ (eg community acceptance). An adaptive strategy (and therefore the governance structures associated with it) must have the flexibility to adjust when required.

Using the example of Melbourne’s water planning in the context of climate change adaptation, Skinner (2010) argues that incremental adaptation will not provide a sufficient response. A transformational change is needed in the planning and delivery of water supply services and also the shape and form of Australia’s cities. He acknowledges that, for this transformation to take place and be resilient, work needs to continue on building the capacity of institutions, organisations and individuals to bring these changes about.

Commentators such as Skinner thereby broaden the concept of resilience beyond organisational flexibility to one that encompasses the concepts of integrated urban water management (IUWM) and water-sensitive urban design. In order to implement the transformational changes referred to above, Skinner maintains, relevant individuals and organisations need to look beyond the water industry and work with other sectors of urban planning. He also points out that the reduced role of catchment storages, the increasing practice of diversifying supply sources, and the need to integrate water and non-water urban planning strategies, mean that a much wider range of water authorities, government bodies and private businesses will be involved in developing and delivering urban water solutions.

Similarly, in its issues paper on building a resilient urban water supply, the UK water services regulator Ofwat identifies the need to ‘join up’ relevant water services legislative and policy frameworks with other sectors, especially those responsible for other forms of national infrastructure (Ofwat 2010). The paper also notes the importance of understanding the financial costs and benefits of resilience investments, which will often affect more than one sector (e.g. state and local government). In addition, Ofwat, the OECD (2013) and WSAA (2014) point to the necessity of incorporating customer input when setting appropriate levels of risk and resilience.

In the face of the many and varied challenges to implementing adaptive management and real options approaches, there has been some recent work in Australia to offer relevant organisations practical assistance:

* Mukheibir et al (2012) point out that in order to address uncertainty while still maintaining water security, large-scale centralised supply infrastructure will in future compete with small-scale and decentralised options. In 2011 he and his colleagues developed an options assessment framework to assist the Melbourne metropolitan water industry in planning for the future, based on the principles of IUWM.
* Maheepala et al (2010) maintain that an integrated approach must be adopted in order for urban water management to become sustainable. Doing so, however, is often outside the scope of any single organisation, and the authors have prepared a manual to assist urban water utilities to work with agencies responsible for other aspects of the water cycle (such as stormwater), and with urban planners, as part of an IUWM planning process.
* Recognising that urban water businesses need planning tools focused on climate change adaptation, WSAA (2012) developed AdaptWater, an online risk and cost–benefit analysis tool.[[3]](#footnote-3) It can quantify and project the probability of damage and failure of assets from existing and future hazards, and assess and compare adaptation options. Practically, the tool enables the user to run scenarios and determine the impact on key financial, operational and environmental performance indicators. This is intended to help utilities to make decisions via a flexible risk management investment/adaptation approach.

Finally, a number of commentators point to the need for further work to be done in order to understand the barriers to and enablers of the implementation of adaptive management approaches. As Smith et al (2013) note, little work has been done on evaluating the success of adaptive management implementation. In their exploration of the compatibility of integrated water resource management and adaptive management, Engle et al (2011) recommend that more research be conducted to investigate the tensions and trade-offs among existing water management regimes and new approaches to address emerging complex stressors. The authors suggest that a full understanding of the legacies of existing approaches will help to guide implementation of more adaptive management institutions and inform practitioners of the factors that can enable or constrain a successful transition.

Maheepala et al (2010) answer these questions to some degree with their case studies of six cities’ attempts to incorporate IUWM in their existing planning practices. Across the six cities (including two in Australia), the silo nature of current government structures was seen as a barrier for adopting IUWM, with each organisation involved in urban water management focused on achieving a set of goals specific to a component of the urban water system. The case studies also demonstrated the importance of incorporating the risks or resilience of system components and their impact on the whole planning system.

Another very recent study of institutional challenges (Keremane et al 2014) found that in Australia a range of governance factors including regulatory conditions, management systems, institutional arrangements and organisational and/or political resistance are impeding new practices. For example, unclear ownership and access rights to new water resources such as stormwater impedes their full consideration in urban water planning frameworks.

Zhou et al (2013), Maheepala et al (2010) and Bettini and Brown (2011) propose that research needs to move beyond identification and discussion of barriers, to a closer examination of the functional ability of institutions to overcome the systemic challenges posed by the adoption of IUWM and adaptive management practices. As Keremane et al (2014) emphasise, effective implementation of an integrated planning approach depends on solutions beyond the technical, to those focusing on the social and institutional aspects of urban water management. The authors acknowledge that there is no ‘one size fits all’ structural arrangement but argue that the focus for the future needs to be on implementing institutional change through reform approaches that emphasise the development of coordinating mechanisms and improving intra- and inter-organisational relationships.

## Urban water plans of four cities

The (publically available) urban water planning documents for the cities of San Francisco, Santa Fe, London and Auckland are briefly discussed here, to illustrate the extent to which they incorporate issues covered by the Australian Urban Water Planning Principles. Aspects of any of the plans that relate to adaptive management and/or IUWM or water-sensitive urban design are also identified.

It has not been possible to undertake a valid comparative analysis with urban water plans from Australia, or among the selected plans themselves, due to the many differences in the content of the plans and the context in which they are developed. For example, there is wide variation in the cities’ urban water governance arrangements, geographical location and climatic conditions. In addition, all the reviewed organisations are wholesalers and retailers of urban water, whereas most Australian utilities are either one or the other. A summary of the urban water providers and the reviewed plans is at Attachment A.

Table 1 provides a summary of each city’s urban water planning documents, in the context of consistency with the key issues expressed in the Principles. The assessment should be interpreted with caution, as it is limited by the online availability of planning documents (e.g. the Santa Fe plan lists a number of appendices that are not publicly available). In addition, this review did not include interviews with relevant urban water planning staff, which could have revealed further key sources of information and the rationale behind certain planning decisions.

Table 1 Assessment of consistency with issues expressed in the National Urban Water Planning Principles

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Principles** | **San Francisco** | **Santa Fe** | **London** | **Auckland** |
| 1. Deliver in accordance with agreed levels of service | Unknown | Unknown |  |  |
| 2. Base planning on best information | Unknown | Unknown | Unknown | Unknown |
| 3. Adopt a partnership approach with customers |  |  |  |  |
| 4. Manage on a whole-of-water-cycle basis |  |  |  |  |
| 5. Consider the full portfolio of options |  |  |  |  |
| 6. Manage supplies within sustainable limits |  |  |  |  |
| 7. Use pricing and markets |  |  |  |  |
| 8. Periodically review plans |  |  |  |  |

**Key:**

|  |  |
| --- | --- |
|  | Substantial discussion of Principle |
|  | Principle mentioned |
|  | Principle not mentioned |

### General comments

* The term ‘levels of service’ does not appear in the San Francisco or Santa Fe plans, but there are references to other requirements, such as state legislation or local regulation.
* All plans contain evidence of data analysis and projections, but it is not possible to know whether this is based on ‘best information’.
* In terms of the extent to which plans reflected whole-of-water-cycle management, all of the reviewed utilities have the capacity to do so, as they are responsible for the supply of water and wastewater management. However, there was no evidence of the consideration of stormwater use, except in Auckland. The Santa Fe plan included consideration of the use of stormwater to recharge aquifers.
* Thames Water does not appear to consider as full a range of options as the other three utilities, but this is probably explained by local climatic conditions – i.e. London is less likely to face ongoing water shortages brought about by drought compared to the North American cities.
* Santa Fe’s plan was the only one to include a reference to pricing in the context of the supply–demand balance. As part of its efforts to diversify urban water supply sources, the plan seeks to optimise the use of treated effluent, including a commitment to ‘determine the value of treated effluent and price the resource accordingly’.
* None of the plans refer to a set of urban water planning principles or guidelines. Watercare states that its Auckland Regional Water Demand Management Plan 2013–2016 is based on WSAA’s 2008 *Guide to Demand Management*, which it claims ‘represents one of the available best practice methods for demand management’.

### Comments on adaptive management

All of the reviewed cities’ plans reveal elements of adaptive management, including the consideration of risk and the use of portfolio approaches. It was more difficult to ascertain evidence of real options planning, but this may have been because those details were not in publically available documents. Some elements of adaptive management in the reviewed plans are:

* San Francisco’s plan includes different sets of options for ‘normal’ and ‘dry’ years, and aims to diversity its water supply choices to include groundwater, recycled water and transfers.
* The Santa Fe plan states that the city considered over 30 different water supply and demand management options and used a custom-built modelling tool to analyse the opportunities and constraints of these options. According to the plan, the options selected using this process would enable the city to meet projected demand without a new major infrastructure project.
* In its long-term strategy, Thames Water states that it plans to address the long-term supply–demand gap through a combination of demand reduction strategies and diversification of supply sources. However, the flexibility of these options and the conditions under which they might be employed are not clear from available planning documents.
* Auckland’s 2008 strategic plan outlines a number of water supply options, such as an increased use of central Auckland aquifers, the use of rain tanks and/or treated wastewater use. Of note is the commitment to review northern source options before any commitment is made to construct a second pipeline from the Waikato River. The plan also states that planning actions are ongoing (implying the willingness and capacity to move beyond static and fixed planning trajectories).

### Climate change

All the reviewed cities incorporate climate change issues into one or more of their plans, but to varying degrees. The issue was addressed most comprehensively by Auckland’s utility Watercare. Its 2008 plan contains a section dedicated to the consideration of climate change, including a consideration of its effect on future rainfall patterns and relevant information sourced from the International Panel on Climate Change. Watercare subsequently commissioned a Climate Change Strategy in 2009, which includes a recommendation to undertake scenario-based planning, including risk analysis and a reduction in the levels of uncertainty.

Both North American plans contain significantly less detail; for example, Santa Fe’s 2008 plan makes only one reference to ‘global warming’ – and in the context of one of a number of ‘uncertainties’ affecting future demand. Interestingly, though, the Santa Fe plan is relatively advanced in its approach to uncertainty: it states that its strategies are designed to withstand and adapt to a range of potential future conditions.

Thames Water’s long-term strategic plan includes a short section on the future climatic variations likely to affect its geographic area and an acknowledgement that the ‘twin challenges’ of population growth and climate change are drivers of a re-examination of possible future water supply sources. In its summary of plans for 2010–15, climate change is addressed in the context of initiatives aimed at reducing the company’s greenhouse gas emissions – for example, a commitment to install thermal hydrolysis technology at a sewage treatment works which will use the methane produced from sewage sludge to generate power.

## Conclusion

This literature review has revealed a widespread agreement among Australian and international commentators that adaptive management approaches are more effective than traditional planning methods in dealing with the complex and varied challenges of contemporary urban water planning, and especially with climate change issues. The analysis of planning documents from four different cities resulted in similar conclusions, with all the plans reflecting aspects of adaptive management, albeit in varying degrees.

One of the most prominent findings of this review is that the literature, particularly from the last four years, is moving away from the ‘what’ of adaptive management towards the ‘how’. Having agreed that adaptive management approaches are effective, the contemporary academic debate seems to be focusing now on the socio-institutional aspects of urban water planning and the need to achieve a ‘transformational’ change in the structures and practices of urban water planning in order to achieve a sustainable supply–demand balance.

However, perhaps of even greater significance to the review of the National Urban Water Planning Principles is that there was no evidence, either in the reviewed literature or the four cities’ planning documents, of an alternative set of national principles or guidelines being used or proposed. One conclusion that can be drawn from this is that the Australian principles were, and continue to be, groundbreaking.

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[www.watercare.co.nz/about-watercare/reports-and-publications/Pages/default.aspx](http://www.watercare.co.nz/about-watercare/reports-and-publications/Pages/default.aspx)

Water Services Association of Australia (WSAA) 2008: ‘Real Options and Urban Water Resource Planning in Australia’ WSAA Occasional Paper No. 20 [www.wsaa.asn.au/WSAAPublications/Documents/Occasional Paper 20 Real options and urban water resource planning in Australia April 2008.pdf](https://www.wsaa.asn.au/WSAAPublications/Documents/Occasional%20Paper%2020%20Real%20options%20and%20urban%20water%20resource%20planning%20in%20Australia%20April%202008.pdf)

WSAA 2012: ‘Climate Change Adaptation and the Australian Urban Water Industry’ WSAA Occasional Paper No. 27 [www.wsaa.asn.au/WSAAPublications/Documents/Occasional Paper 27 Climate Change Adaptation and the Australian Water Industry March 2012.pdf](https://www.wsaa.asn.au/WSAAPublications/Documents/Occasional%20Paper%2027%20Climate%20Change%20Adaptation%20and%20the%20Australian%20Water%20Industry%20March%202012.pdf)

WSAA 2014: ‘Urban Water Planning Framework and Guidelines’ WSAA Occasional Paper No. 29 [www.wsaa.asn.au/WSAAPublications/Documents/Occasional Paper 29 Urban water planning framework and guidelines March 2014.pdf](https://www.wsaa.asn.au/WSAAPublications/Documents/Occasional%20Paper%2029%20Urban%20water%20planning%20framework%20and%20guidelines%20March%202014.pdf)

Zhou, Q 2013: ‘Towards Adaptive Urban Water Management: Up-scaling Local Projects’ *International Journal of Architecture, Engineering and Construction* 2(1)

**ATTACHMENT A**

**Summary of reviewed cities’ urban water providers and plans**

|  |  |
| --- | --- |
| San Francisco | |
| Organisation | San Francisco Public Utilities Commission – municipal utility |
| Plan(s) reviewed | Urban Water Management Plan 2010–2015 |
| Service area details | Wholesaler and retailer servicing approximately 2.5 million people |
| Santa Fe | |
| Organisation | City of Santa Fe – municipal utility |
| Plan(s) reviewed | ‘Long-range’ plan, commencing from 2008, unspecified end date (projections are to 2045) |
| Service area details | Wholesaler and retailer servicing approximately 79,000 people |
| London | |
| Organisation | Thames Water – company owned by consortium of institutional investors |
| Plan(s) reviewed | Summary of Strategic Plan 2010­–2015  Business Plan 2015–2020 |
| Service area details | Wholesaler and retailer servicing approximately 9 million people |
| Auckland | |
| Organisation | Watercare – council-owned not-for-profit enterprise |
| Plan(s) reviewed | Three Waters 2008 Strategic Plan  Watercare Climate Change Strategy 2009  Auckland Regional Water Demand Plan 2013–2016  Watercare Asset Management Plan July 2012–2022 |
| Service area details | Wholesaler and retailer servicing approximately 2.5 million people |

1. C. Pahl-Wostl et al 2007, ‘Managing Change toward Adaptive Water Management through Social Learning’ [↑](#footnote-ref-1)
2. WSAA 2008, *Real* *Options and Urban Water Resource Planning in Australia* [↑](#footnote-ref-2)
3. This tool focuses on the adaptation of urban water and sewage infrastructure assets but does not address urban water supply security. [↑](#footnote-ref-3)